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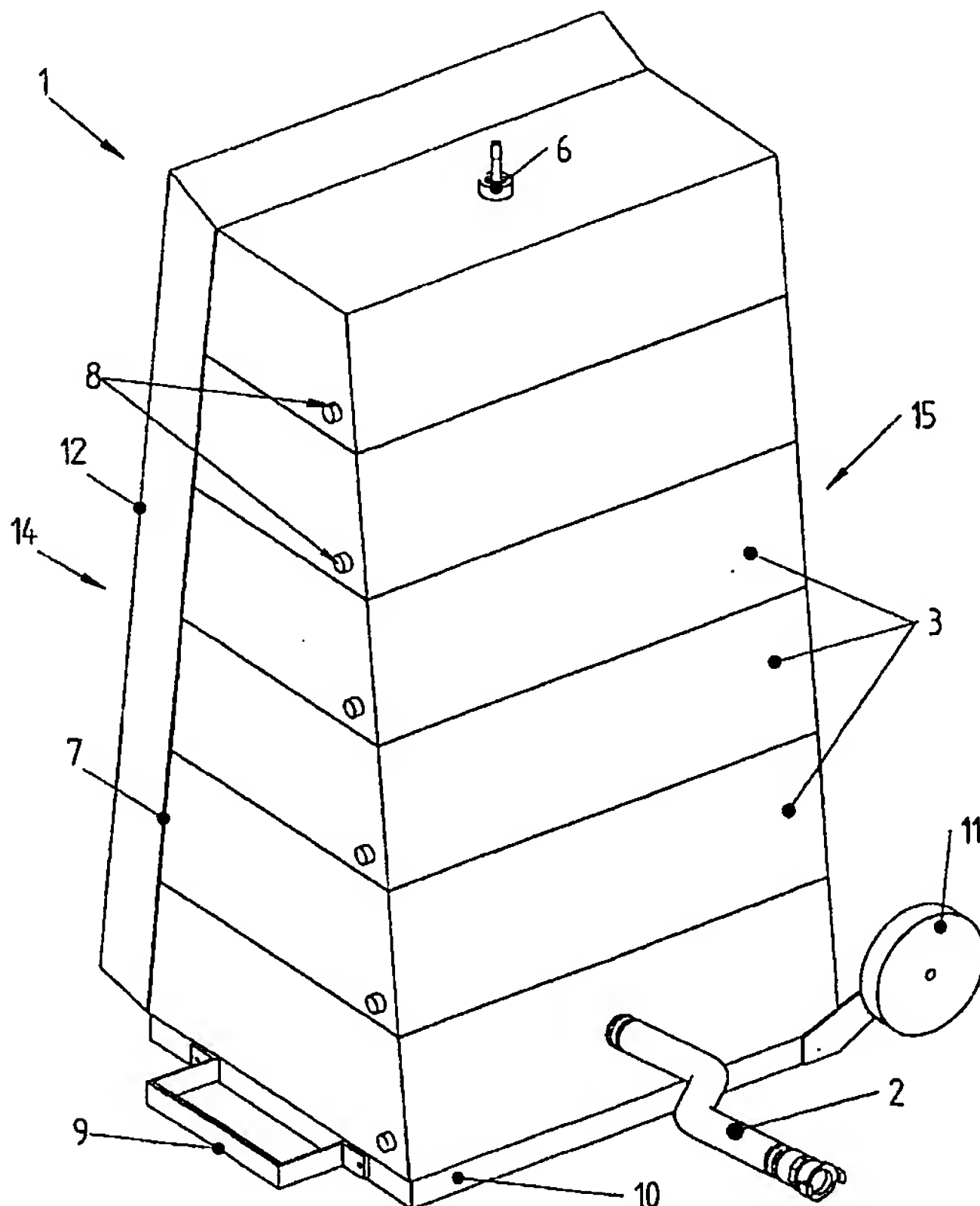
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(54) Title: METHOD AND SHIELD STRUCTURE AGAINST FLYING BODIES AND SHOCK WAVES



(57) Abstract: The invention relates to a shield structure (1) against flying pieces, such as bullets, fragments, and other similar bodies, in order to stop them or to reduce their impact force, formed of a hollow structure (1), which is filled with, or can be filled with a medium, and with its aid brought into an operating state. The shield structure is compartmentalized (3) and contains an absorbent material (4), which is able to absorb the medium. The invention also relates to a method, with the aid of which it is possible to stop flying bodies, or to reduce their impact force.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method and shield structure against flying bodies and shock waves

The present invention relates to a method and shield structure against flying pieces, such as bullets, fragments, and other similar explosive or other bodies containing a large amount of impact energy, as well as shock waves, in order to stop them, or to reduce their impact force.

The invention is based on a problem, which is caused by bullets, projectiles, shrapnel, fragments, or their ricochets, which should be stopped by an obstacle or structure suitable for the purpose, which can be erected and deployed rapidly. Previously, such bullets, projectiles, or fragments have been stopped, and their impact force absorbed using sandbags, shields made from ballistic plates, or tent-like structures filled with a foam that attenuates explosions or impact force. These cause not only an impact force, but also a pressure effect, which should be reduced, or the greatest part of which should be directed to the shield structure instead of to the object being protected, thus preventing damage or injury to the object or person being protected.

The invention is further based on a problem, in which a crowd, for example a crowd of demonstrators, should be separated from law enforcers and retained and isolated in a specific, restricted area. For this purpose, various riot barriers or obstacles made of metal or composite materials have been used, which can be erected, for example, with the aid of a rapidly expanding foam or gel placed inside fabric.

An example of such an obstacle erected with the aid of a foam is disclosed in US patent publication 4 541 947. It discloses a method for controlling a crowd or demonstration by using an barrier filled with the aid of a rapidly expanding foam. The inflation substances referred to are carbon or hydrogen fluoride surfactants, which are used to prevent fuel vaporizing in accidents. The expansion coefficient of such surfactants is stated to be 50:1, or even 1000:1.

The solution disclosed in the aforementioned patent publication is not, however,

suitable for stopping or reducing the impact force of flying projectiles, such as bullets, shrapnel, and fragments, because the foam used for inflation does not dissipate the projectiles and their impact force is sufficient to penetrate the structure in question.

Various solutions absorbing bullets, projectiles, and shrapnel and protecting against them are disclosed in, for instance, US patent publications US 6 412 391 B1 and US 6 029 558 A. They depict a bag-like shield structure, made particularly of Kevlar or Spectra fibres, which can be rapidly deployed and filled through a valve automatically from a control signal.

A corresponding gas-filled shield structure is disclosed in US patent publication US 6 266 926 131.

A drawback of such gas-filled structures is that at least projectiles will ricochet from the surface of the structure when they strike it, in which case they will not dissipate in the actual shield structure, but may cause danger and damage to the surroundings.

Further, another type of solution is disclosed in European patent publication EP 323 763 B1. This describes a shield structure, which consists of at least one polyamide-type (such as aramid) layer, which further consists of several polyamide plates, laminates, or membranes of differing thickness and density, each of which has a different modulus of elasticity.

A drawback of such a structure is its size and the increase in weight due to the additional layers or laminates, which make the structure difficult to transport and to deploy very quickly.

A further transportable bullet-shield construction is disclosed in US patent application publication US 2003/0167911 A1.

In the bullet-shield construction, there is a lower part made of metal, plastic,

ceramic, or composite materials, which is pushed on wheels, and which protects the lower body, and a transparent upper part that protects the upper body. Such a structure has the drawbacks of size, transportation, and the ricocheting of projectiles into the surroundings.

The invention is intended to eliminate the defects of the bullet-shield structures described above. The invention provides a transportable and rapidly inflatable and deployable protection against bodies, which also dissipate in the actual structure and do not ricochet into the surroundings.

The invention is an easily transportable shield, which is massive when in operating condition, against fragments, shrapnel, bullets, projectiles or their ricochets, and pressure. In addition, the shield can be used to restrict routes. The shield can be easily deployed both indoors and outdoors. The shield can be utilized in many different dangerous situations. The basic idea of the shield is implemented in many different forms of the shield. The outer appearance of the shield can be freely selected, for example, in the form of various surface patterns. A gel mass acts as a flexible factor behind a ballistic plate, if such is used, which helps to reduce the energy of the projectile. The shield is deployed with the aid of water, which is available nearly everywhere. The shield can be brought to the location without attracting attention and is light when dry. The shield is manufactured from relatively easily obtainable materials.

The invention combines the most important properties required in a protection structure, these being certain ballistic protection, massiveness, rapid and simple deployment, and adaptability to different danger situations. The combination of properties permits better protection than at present, for instance, in dangerous situations, in which both ballistic protection and a restriction of routes are required simultaneously. The shield solution according to the invention differs from the solutions described above, in that in its transportable state it is light and can be moved by one person, while in its operating state it is, however, extremely massive. In addition, it can be deployed quickly and easily.

Solutions that are stated to be characteristic of the invention are described in the accompanying Claims.

In the following, the invention is examined with reference to the accompanying drawings, in which:

Figure 1 shows the shield structure in the operating position;

Figure 2 shows the shield structure seen from another direction, with the wall cut away;

Figure 3 shows the shield bags of the shield structure equipped with ballistic or shield plates; and

Figure 4 shows the shield structure in the transportation state.

In the following, reference is made to all of the figures in parallel, in order to provide a good depiction of the invention.

In the shield structure 1, there is a front wall 12 of the dry part and a front wall 7 of the wet part. In addition, there are openings in it, with shut-off valves 8 in them from filling and emptying the compartments, as well as a handgrip 10, a base plate 10, and moving elements 11 for moving and transporting the shield structure. It should be noted, however, that the dry part 14 is a part that provides additional safety in certain situations, and its not essential within the scope of the basic idea of the invention.

In the dry part 14, there is preferably a bag-like space or spaces 13 for the placing of the ballistic plates 5, as is shown by way of example in Figure 3.

The wet part 15 of the shield structure consists of compartments 3, in each one of which there is a filling connection 16. In the wet part, there is a connection 2, such as a valve, coupling, or similar, preferably equipped with an operating element, for feeding a medium. In each compartment, there is a portion of absorbent material 4.

The absorbent material is generally a material that begins to expand through the effect of a medium, particularly water, to form a gel. One such product, which is well regarded, though it is by no means the only one, is a polymer product marketed by BASF AG, which the marketer terms a super-absorbent. Such a polymer substance can absorb up to 1000 times its weight of medium. At the same time, the retention of the medium is excellent. Together with the medium, the polymer form a solid gel, which can be returned to a liquid by a simple operation.

The shield 1 is brought to the point of use by pulling it from the handgrip 9 attached to the base frame 10. Wheels 11 are also attached to the base frame 10, to facilitate movement. The shield 1 is set with the base frame against the ground and the front wall 12 facing the direction of the danger. The filling hose is attached to the connector 2 and the medium, especially water, is sprayed into the shield 1.

The compartments 3 lying on top of each other are connected to each other by feed-throughs or filling connections 16. The shield 1 begins to fill one compartment 3 at a time, starting, in this case, from the lowest compartment 3. At the same time as shield 1 is being filled, the water begins to be absorbed in the absorbent material 4 located in each compartment 3, the hydro-gel begins to form. At the same time the shield 1 starts to rise into its use position.

The absorbent material is inside the compartments, in a form that reacts rapidly with the medium being fed into it. In practice, this means that it is mostly in a fine-particle form, such as a powder.

When ballistic plates 5 are being used, they rise along with the shield 1. The ballistic plates 5 are located in their own bag-like spaces 13, which are attached at their upper edges to the front wall 7 of the wet part 15 of the shield 1. The ballistic plates 5 with their bags 13 are located in their own separate space, in the dry part 14. The shield 1 is filled until water or hydro-gel comes out of the air-bleed valve 6, when the air-bleed valve 6 is closed.

Any, as such known, structure, by means of which the desired shielding effect is achieved, can be used as the ballistic plates. Such, as such known, plates can be of metal, but more preferably of some lighter material, for example, a Kevlar-based plate.

The shield structure is manufactured from appropriate material. The material is preferably flexible, to permit, for example, the entire structure to be folded up, as shown in Figure 4. The material should, however, be sufficiently strong to withstand the pressure of the mass inside it and the pressure of a shock wave acting on it, in addition to which it should be essentially watertight, because the medium, which is usually used in this case, is water. A strong fabric-like tight material is quite suitable for this purpose.

The shield structure 1 is emptied by adding a salt solution through the air-bleed valve 6. The salt solution is allowed to act for a few minutes. The shield 1 is emptied one compartment 3 at a time. The upper compartment 3 is emptied first, by opening the screw plug 8 at its side. This is continued until the lowest compartment 3 has been emptied. The compartments 3 can be flushed, by opening the screw plugs 8 at both sides and spraying water through the compartment 3. The shield 1 should always be flushed into a sewer, and not straight into nature.

The salt solution is suitable when using the aforementioned super absorbent made by BASF AG, in which sodium ions play a significant part in the formation of the gel. It is obvious that other gelling agents can also be used and the mechanisms for returning them to a solution state may be completely different.

The shield structure according to the invention has been demonstrated to be excellent for the purpose described. The shield structure according to the invention will retain its shielding effect, even if a fragment penetrates the wall of the shield structure, as the gel inside the structure will not begin to flow out of a small, or even a slightly larger hole and empty the structure.

In practical tests, which have been made by exploding an explosive charge that does or does not discharge fragments in the immediately vicinity of a deployed shield structure according to the invention, it has been observed that, surprisingly, the shock wave is able to move the shield structure to only a very limited extent. Thus, there is also a good shielding effect against a shock wave.

After use, the shield structure is dismantled and put into the storage state by leading the mixture of absorbent and water out through a valve.

The shield structure can also be implemented by combining the shield plate, an operating element equipped with a connection, and an absorbent, for example, to form a case-like structure in the manner according to Figure 4. Thus, the structure can be transported and moved easily.

The invention can be varied within the scope of the Claims stated hereinafter.

Claims

1. A shield structure (1) against flying pieces, such as bullets, fragments, and other similar bodies, in order to stop them or to reduce their impact force, formed of a hollow structure (1), which is filled with, or can be filled with a medium, and with its aid brought into an operating state, **characterized** in that the shield structure is compartmentalized (3) and contains an absorbent material (4), which is able to absorb the medium.
2. A shield structure according to Claim 1, **characterized** in that the absorbent material (4) is of a type that forms a gel with the water that is used as the medium.
3. A shield structure according to Claim 1, **characterized** in that the shield structure (1) is formed from a fabric-like material.
4. A shield structure according to Claim 1, **characterized** in that the compartments (3) are connected to each other by filler connections or openings (16) in their partitions and that the structure includes a connection (2) for leading the medium into the structure, in the compartment that is situated lowest in the structure.
5. A shield structure according to any of the above Claims, **characterized** in that the structure also includes a separate compartment (14) for situating ballistic plates (5) or similar protective means.
6. A shield structure according to Claim 5, **characterized** in that the compartment (14) is located on the side of the shield structure facing the danger.
7. A shield structure according to any of the above Claims, **characterized** in that in each of the compartments (3) of the structure there is at least one emptying connection (8) and that the uppermost compartment has also a

separate connection (6) in its uppermost part.

8. A method for stopping flying bodies, such as bullets, fragments, and similar, or for reducing their impact force, by using a shield structure, which consists of a shield structure (1) that is filled, or can be filled with a medium, **characterized** in that

- the said shield structure is compartmentalized (3) and equipped with filling connections (16) between the compartments;
- a quantity of absorbent material (4) is placed in the shield structure, and is able to form with the medium, for example, a gel-like composition;
- the medium is fed into the shield structure, in order to form a gel in the compartments, in order to fill them and to raise the shield structure to the shielding position.

9. A method according to Claim 8, **characterized** in that the medium, particularly water, is led into the shield structure through the connection (2) or similar in the lowest compartment (3) and from there through the filling connections (16) to the other compartments.

10. A method according to Claim 8, **characterized** in that a quantity of the absorbent material (4) is situated in each of the compartments (3).

11. A method according to Claim 8, **characterized** in that the shield structure is also equipped with a separate compartment (14) containing ballistic plates (5) or similar protective means.

12. A method according to any of the above Claims 8 - 11, **characterized** in that the shield structure (1) is equipped with a connection (8) for emptying it.

13. A method according to any of the above Claims 8 - 11, **characterized** in that the shield structure is equipped with a separate compartment (14), in which there are ballistic plates.

14. A method according to any of Claims 8 - 13, **characterized** in that the gel that creates the shield is liquified after user, by using, for example, salt, for emptying the shield.

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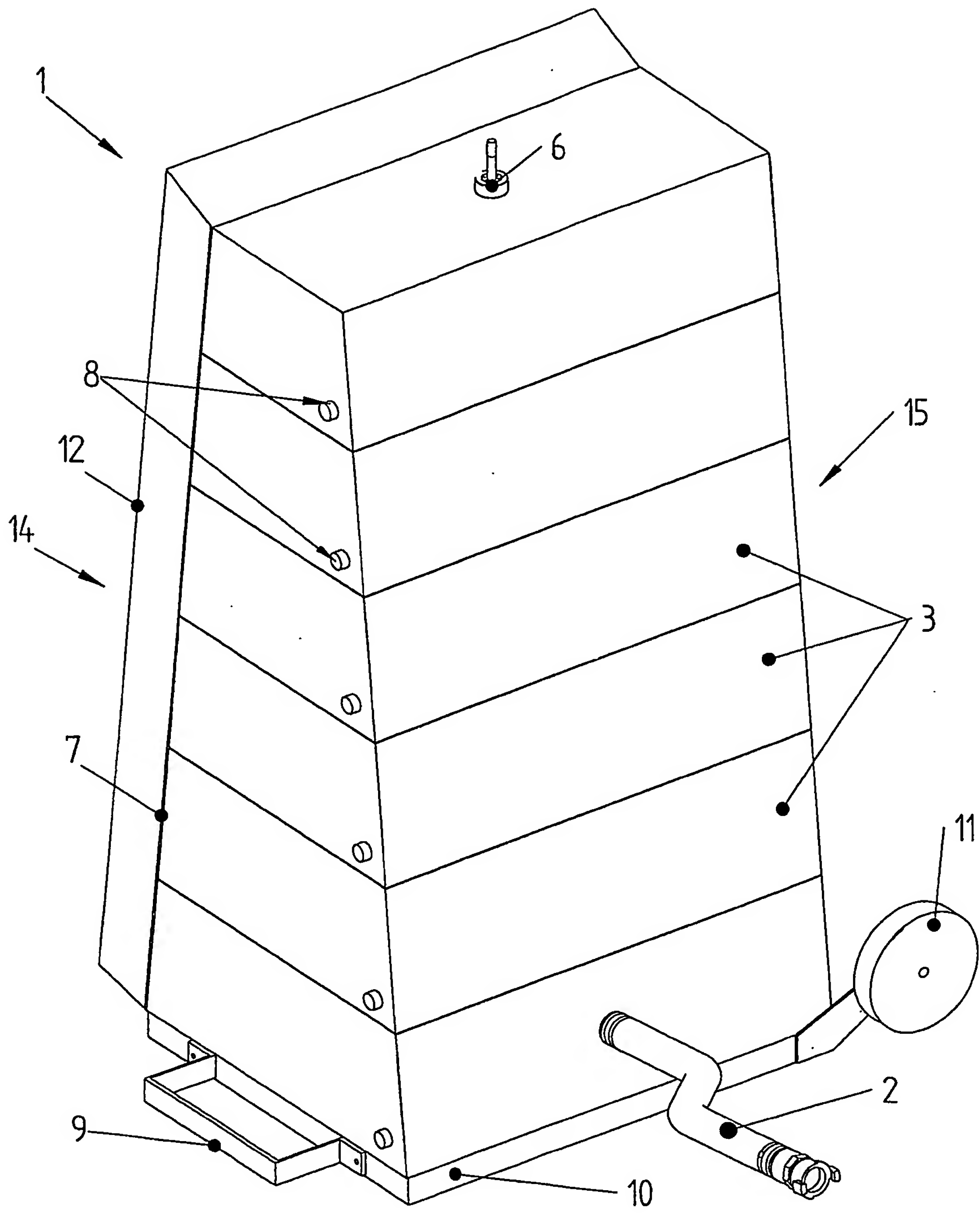


Fig. 1

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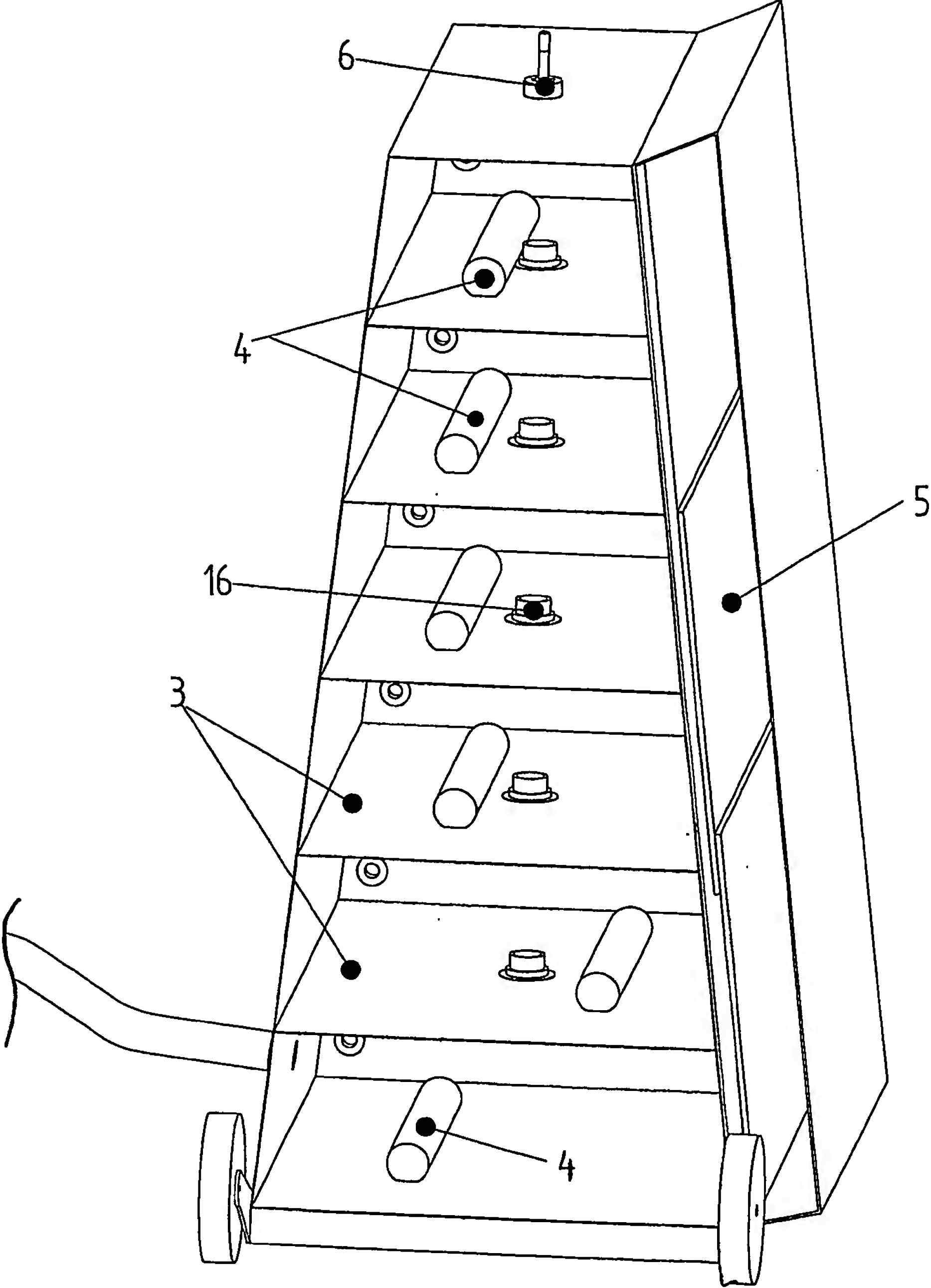


Fig. 2

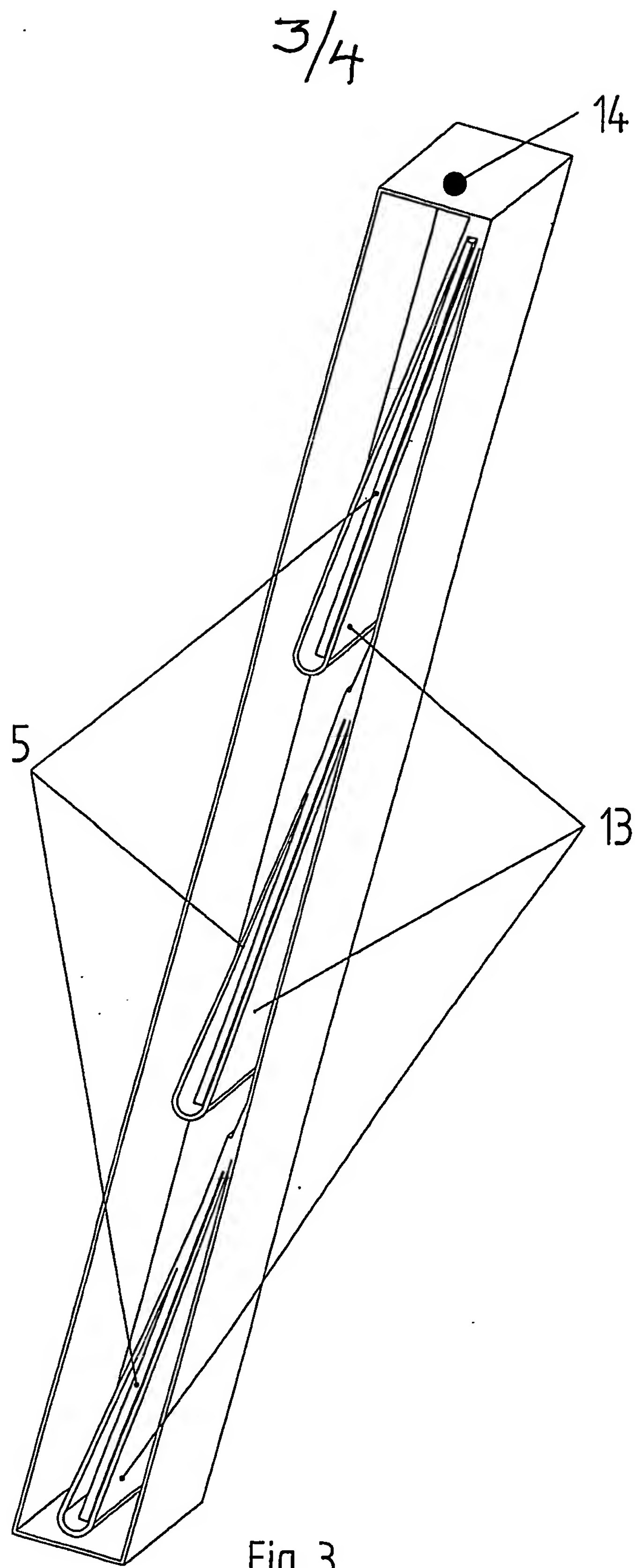


Fig. 3

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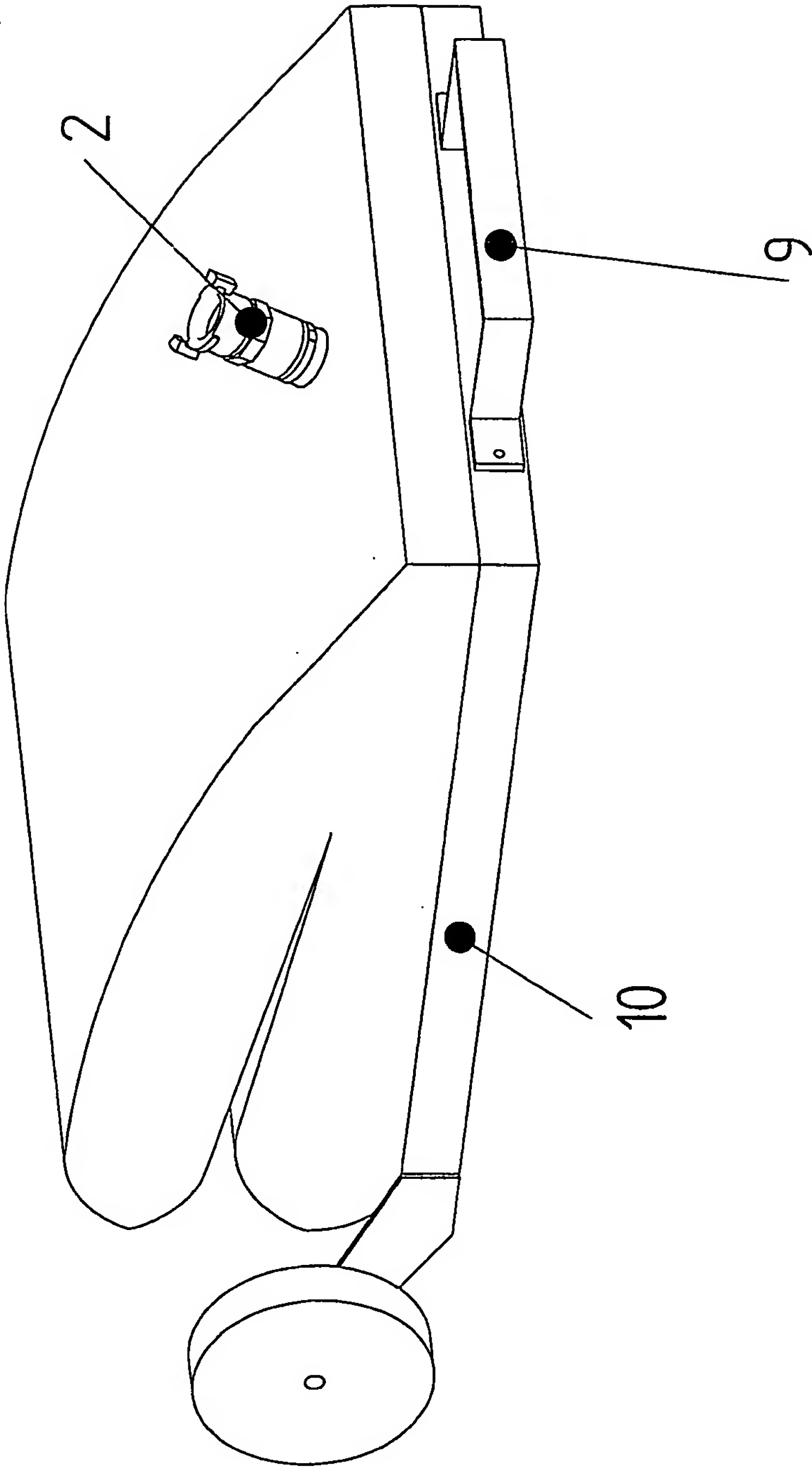


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2005/000102

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F41H 5/00, F41H 5/14 // F41H 11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F41H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4589341 A (CLARK ET AL), 20 May 1986 (20.05.1986) --	1-14
A	US 4782735 A (MUI ET AL), 8 November 1988 (08.11.1988) --	1-14
A	US 6439100 B1 (JUNG ET AL), 27 August 2002 (27.08.2002) -- -----	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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